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UNION OF SOUTH AFRICA

DEPARTMENT OF MINES

THE TRAVERTINE DEPOSITS near Port St. Johns

BY

W. KUPFERBURGER, D.Sc.
Geologist

PUBLICATION OF THE GEOLOGICAL SURVEY DIVISION

THE GOVERNMENT PRINTER, PRETORIA
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The Travertine Deposits near Port St. Johns.

INTRODUCTION.

Near Port St. Johns along the western or right bank of the Umzimvubu River there are two deposits of calcareous rock of considerable dimensions, one at Isinuka and the other 13 miles further upstream on the inner side of a big bend in the river. The localities are respectively about 5½ and 18 miles up the river from Port St. Johns.

The deposits have been known for a long time and are mentioned by du Toit in his description of the geology of the area included in Geological Survey Map, Cape Sheet 28, Pondoland, published in 1920.

Apart from the fact that they can be regarded as potential sources of lime, attention has recently been focussed particularly on the upper or " Crater " deposit as a source of marble for building purposes.

In the building trade all calcareous rocks capable of taking a polish are regarded as marble, although a distinction can be made between " crystalline " marble and " travertine " marble. This broad distinction corresponds to a difference in the mode of origin. Generally speaking crystalline marbles are the result of the recrystallisation of pre-existing calcareous rocks under conditions of intense heat and high pressure, whereas " travertine " marble is the result of deposition of calcium carbonate from spring waters.

The crater deposit belongs to the latter category, and contains several varieties, due to differences in colour shades and texture, of ordinary travertine as well as some beautifully translucent varieties of onyx marble. Polished slabs and blocks of the marble indicate that it should be suitable for both exterior and interior building purposes, and that some of the varieties of the travertine and onyx marble could be used for interior decorative work.

THE CRATER DEPOSIT.

The country rock in that area is Dwyka Tillite which is well exposed on both sides of the river. Along the steep hillsides which flank the eastern or left bank of the river there are nearly vertical cliffs of Dwyka Tillite up to 200 feet high in places.

The deposit of travertine and onyx marble which is now being quarried takes the form of a low asymmetrical conical mound with a distinct crater-like depression at the summit. The travertine was deposited on a more or less flat platform of Dwyka Tillite with a gentle slope in an easterly and north-easterly direction towards the

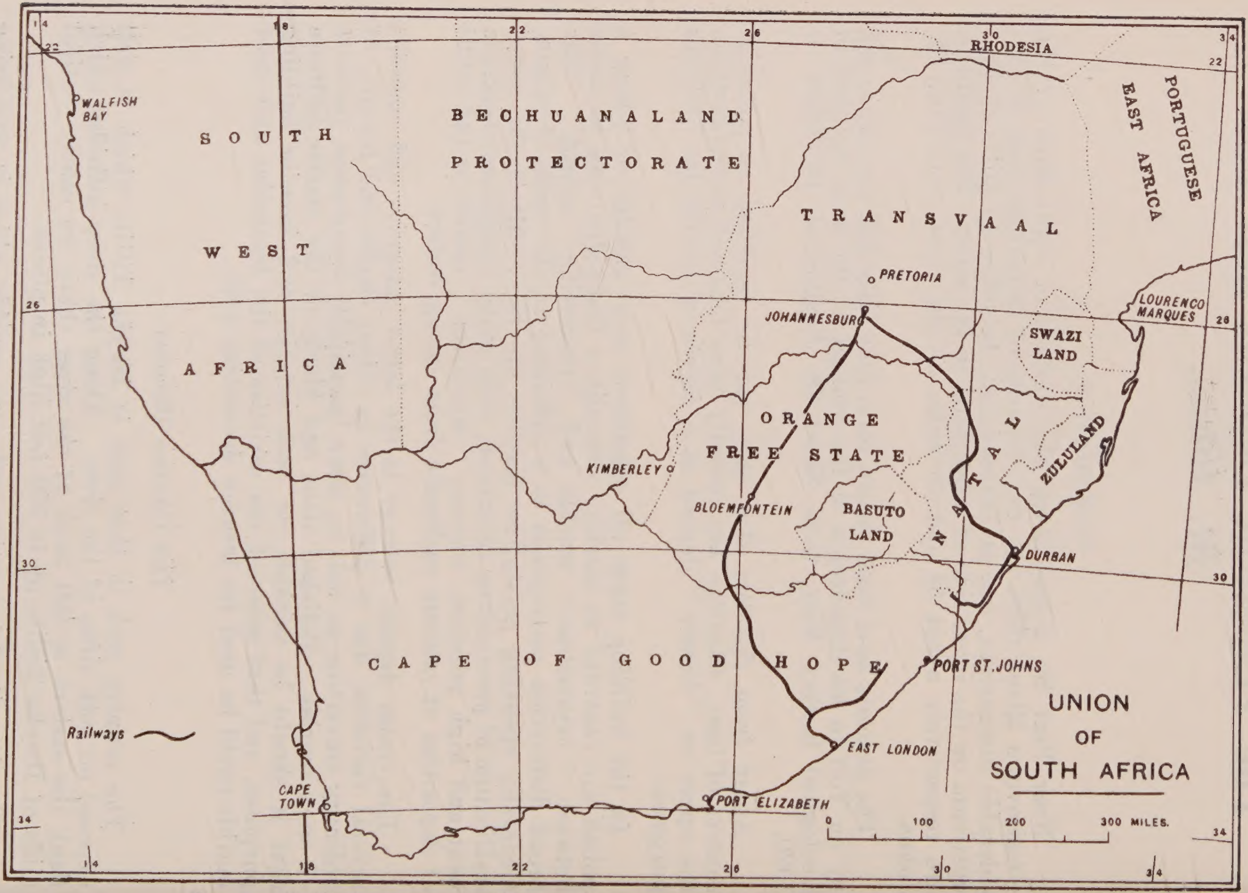


Fig. 1.—Outline map of the Union to show locality and nearest Railway routes

river. The height of the platform is about 250 feet above the present level of the river bed on the eastern and north-eastern sides adjoining the river and about 400 feet on the western side. Since the deposition of the travertine the course of the river has been lowered by erosion to the extent of about 250 feet, leaving steep banks and cliffs of Dwyka Tillite on either side and strips of rich alluvial soil, with coarse shingle and gravel at the base, on the left bank or inner side of the bend in the river. There are two well-defined alluvial terraces, one at about 10-15 feet and another 25-35 feet above the present level of the river.

The outline and extent of the travertine deposit on this gently sloping platform and of the Dwyka Tillite can be seen from the accompanying geological sketch map (Fig. 2). The mining area held by the Company as indicated on the map enclosed within the beacons A B C d e F is approximately 32 morgen (67·5 acres) in extent and it covers the greater part of the deposit. The deposit is roughly elliptical in outline. The longer axis, striking N.W.-S.E., is approximately 2,500 feet and the shorter axis, striking N.E.-S.W., approximately 1,300 feet in length.

The deposit is naturally divisible into two portions:—

(*a*) A lower and outer basal portion which slopes gently from the periphery upwards towards the centre. This basal portion is absent in the north-eastern quarter where there are vertical cliffs and a generally steep descent towards the river to well below the contact of the travertine and Dwyka Tillite. In this quarter the basal portion of the deposit has undoubtedly been removed during the course of the erosion of the river bed to its present level.

This basal portion of the deposit has a gradually increasing thickness up to a maximum of possibly 100 feet. The surface of the outer portion is covered with soil and grass and there are but a few outcrops. The actual base can be seen on the steep slopes along the side of the river and elsewhere at the following points: (i) along the road cutting near the camp; (ii) in a small gully 400 feet west of the western quarry; (iii) along a pathway down to the river a few hundred feet south of Beacon A.

(*b*) An inner portion which constitutes a distinct conical rocky mound rising approximately 150 feet above the contact with the basal portion. The base of the mound is roughly elliptical in outline corresponding to that of the outer portion of the deposit and the summit is formed by the rim of a crater-like depression. The rim of the crater is approximately 350 feet in diameter and its floor is about 75 feet below the rim. The rim of the crater is broken on the N.E. side by a natural gap about 30 feet wide extending down to the floor of the crater. This is not an original gap in deposition of the travertine but was most probably caused by the breaking away of a portion of the rim due to the undercutting by the river when it flowed at a con-

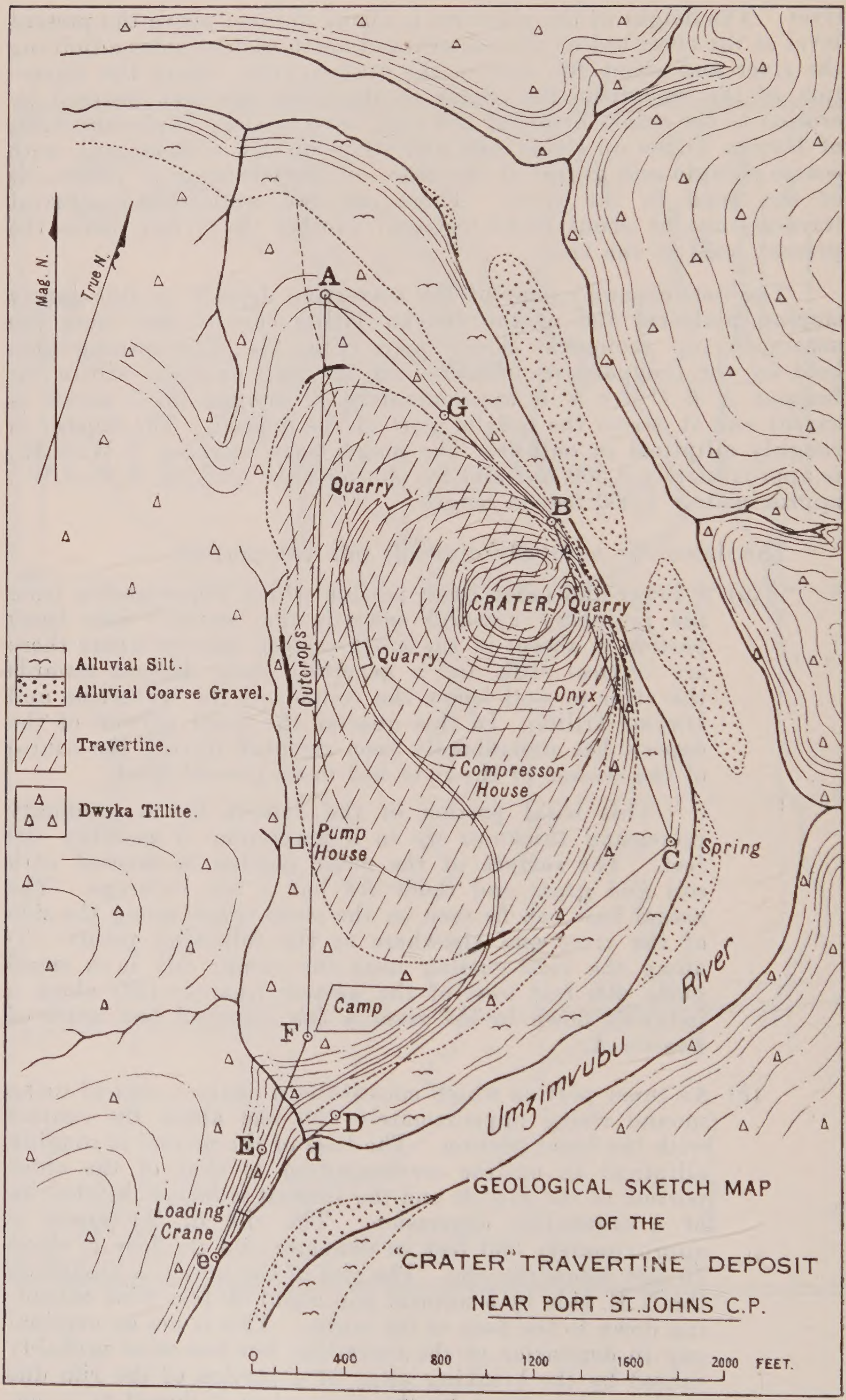
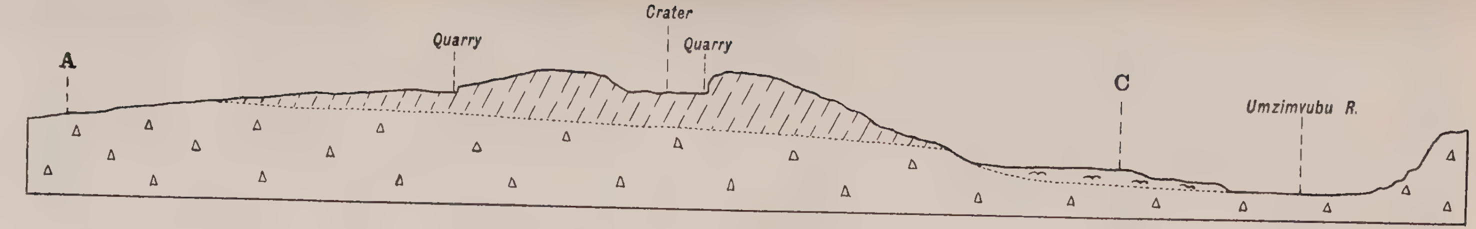
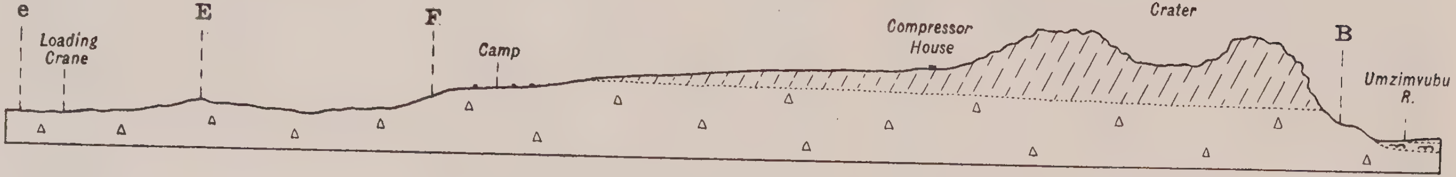

Mag. N.
True N.
A
G
B
C
D
E
F
d
e
Quarry
CRATER
Quarry
Quarry
Onyx
Outcrops
Compressor House
Pump House
Spring
Camp
Umzimvubu River
Loading Crane
Alluvial Silt.
Alluvial Coarse Gravel.
Travertine.
Dwyka Tillite.
GEOLOGICAL SKETCH MAP
OF THE
"CRATER" TRAVERTINE DEPOSIT
NEAR PORT ST.JOHNS C.P.
0
400
800
1200
1600
2000 FEET.

Fig. 2.



SECTION THROUGH BEACONS A AND C.



SECTION THROUGH BEACONS e, E, F AND B.

Fig. 3.

siderably higher level than it does to-day. The gap ha since then probably been widened by the normal weathering of the travertine.

The travertine is well exposed on all sides of this rocky mound as well as on the inner slopes of the crater-like depression. Th western and southern slopes of the mound are covered with larg irregular blocks of weathered travertine and on the northern an eastern sides due to the steep descent to the river the travertine i exposed in vertical cliff faces from 10 to 50 feet in height.

Where exposed the travertine is seen to have an irregular, wavy horizontal stratification and is jointed vertically. Both thes features coupled with the good exposures on the slopes of the hill a well as on the inside of the crater make for easy and cheap quarrying

The travertine was undoubtedly formed by deposition from strong spring which contained calcium carbonate in solution an which issued at a point corresponding more or less to the centre o the present crater. The roughly horizontal stratification of th travertine indicates that the water once overflowed from the sprin in all directions and deposited calcium carbonate in the form more or less horizontal terraces.

At present there is no spring issuing from the crater, but belo the base of the travertine deposit in the coarse gravel exposed alon the course of the river, cold springs with a high saline content issu at several places. There is a pronounced odour of sulphurette hydrogen in the neighbourhood of the springs. Where the spring issue from the gravel bed above the level of the water the pebbl and sand are cemented to a hard, compact mass by the salts deposite by evaporation of the spring waters.

The emergence of the spring water and the deposit of travertin at this locality is not so clearly related to a fault plane as a Isinuka but nevertheless it lies along the axis of the monoclina flexure by which the Karroo beds have acquired their seaward di along this part of the South East Coastal belt in contrast to the lo dip towards the interior of the same formation further inland. Th underground water must have found some suitable channel along th line of weakness and have risen to the surface along joint planes i the Dwyka.

The bulk of the material exposed is fine-grained travertine wit undulating horizontal bands of varying colours, creamy white, pal yellow, grey and brown. It contains numerous elongated cavitie also arranged horizontally in alignment with the colour banding o the rock. The cavities are usually lined with minute crystals o calcite stained brown with iron and manganese oxides.

In some places, notably on the south-eastern, outer side of th deposit, and on the same side of the interior of the crater, there a layers, veins and irregular cavity fillings of beautiful, compact an translucent onyx marble. It is composed of aragonite with paralle or radiating columnar crystallisation and banded with irregula colour-markings in white, greyish-pink, light and dark amber an several other delicate shades.

The deposit has not been opened up sufficiently to indicate the distribution and extent of the different varieties of travertine and onyx marble that it will no doubt be possible to obtain. Sufficient work has, however, been done to show that a wide range in colour and design will be available. Variations in the finished marble are also obtained by cutting the crude blocks in different directions either at right angles or parallel to the banding.

Estimated Tonnage.

Disregarding the flat outer portion of the deposit, which is covered with a soil overburden of several feet and which has not been opened up anywhere, a rough estimate of the amount of rock available for quarrying in the central well-exposed rocky portion of the deposit gives a figure of 6,000,000 tons. Allowing for a wastage of one-third during the process of quarrying and rough trimming of the rock into crude rectangular blocks, this gives a figure of 4,000,000 tons of crude marble.

In the beginning, near the outcrop the wastage will be one-third, if not more, but once good faces are exposed the installation of wire saws will reduce the wastage considerably.

Quarrying Methods.

Up to the present quarries have been opened up and good working faces exposed on the western, north-western outer side of the central mound and on the eastern inner side of the crater. A compressor and the necessary power plant have been installed and two Italian workmen are in charge of the quarrying operations.

The method of quarrying at present adopted is briefly as follows:—

> After the loose rubble has been removed the blocks of travertine are broken by drilling a series of holes in a row with compressed air driven rock drills and then by driving wedges into the holes. Advantage is taken as far as possible of the natural banding and jointing of the rock. In this way rectangular blocks of varying sizes are produced. At present the blocks are broken so as not to exceed 3 to 4 tons in weight, as arrangements for the handling and transportation of larger blocks have not yet been completed. Eventually it is proposed to ship blocks up to a maximum of 15 tons in weight.

Transportation.

There is no road all the way to the deposit and the nearest approach along a passable road is as far as the farm of a Mr. Myburgh, 12 miles up along the right bank of the Umzimvubu river. This road branches off from the Port St. Johns-Umtata road to the right near the Isinuka sulphur spring. From Myburgh's farm the rest of the journey must be done by river.

The blocks of crude marble are transported on hardwood sleds along a graded roadway from the quarries down to the landing stage on the river bank at the southern extremity of the claim area—over a distance of half to three-quarters of a mile.

At this point a well constructed crane and steel-frame gantry with a capacity of 15 tons has been erected on a solid rock ledge about 30 feet above the river level. At present the blocks of marble are transferred by means of this crane and gantry into flat-bottomed barges and floated down to the river mouth at Port St. Johns. At Port St. Johns the marble blocks are transferred to a coastal steamer for shipment to Durban.

It is the intention of the Port St. Johns Marble Co., to erect a landing stage and 15 ton steel crane similar to that at the quarry at a point on the Umzimvubu near the Isinuka sulphur springs in the near future. The river channel is sufficiently deep up to this point to enable the sea-going steamboat to come up to this landing stage and load the blocks of travertine for direct shipment to Durban.

Unfortunately the flow of the Umzimvubu is subject to several fluctuations as well as to occasional floods during the rainy season. Furthermore, there are four rapids along the upper six miles of the river over which the marble will have to be transported. During the rainy season these rapids are negotiable by flat-bottomed boats and barges, but during the dry season when the river is low they are likely to be serious obstacles in the way of continuous transportation of the marble.

The transportation of the marble from the quarry to the coastal steamer for shipment to Durban or any of the other ports is at present the weak link in the chain from the initial production to the final disposal of the marble.

The Company is, however, giving serious consideration to the problem, and will no doubt find a satisfactory solution. There are the alternative methods of road and river transport to be considered. In view of the highly dissected, hilly nature of the country and the heavy loads to be carried, the former method is bound to be more costly and less practicable than the latter, provided some satisfactory solution to the question of the transportation of the marble over the upper six miles of the river can be found.

THE ISINUKA DEPOSIT.

This deposit is situated about half a mile up the valley of a small tributary stream which enters the Umzimvubu River about five miles from Port St. Johns. The locality is better known under the name of Sulphur Springs, on account of a cold salt spring, the water of which is milky with sulphur derived from the oxidation of the sulphuretted hydrogen which bubbles up in the pool where the spring issues. The spring is a few hundred yards south-west of the road about six miles from Port St. Johns on the road to Umtata. The limestone deposit is a little higher up the valley. According to du Toit similar water issues out of joints in the Dwyka Tillite in a little gorge branching to the East. These springs are situated in the westerly extension of the " relatively raised fault block " or St. Johns " horst " and du Toits explanation that they owe their position to the faulting associated with this structural feature must be accepted.

As in the case of the Crater deposit, the travertine here occurs as a mound formed by the deposition of calcium carbonate from spring waters which issued at a considerably higher level than that of the present springs. The deposit is considerably smaller than the Crater deposit.

The central mound which also has a small crater-like depression at its summit rises to about 80 feet above the floor of the valley and rests on a flatter basal portion of travertine approximately 20 feet thick.

The upper portion of the travertine is soft and friable and while the basal portion is harder and more compact it has not been found suitable for cutting and polishing. It is however quite suitable for lime burning purposes, the average calcium carbonate content being in the neighbourhood of 93 per cent. (see analysis on p. 15).

WORKING ARRANGEMENTS.

The St. John's Marble and Base Mineral Ltd., has secured mining leases over both the Isinuka and "The Crater" deposits but is confining its activities at present to the exploitation of the travertine and onyx marble of the Crater deposit. The object of the company is to mine and dispose of the marble in crude, roughly trimmed rectangular blocks of any size that may be required, to stone cutters and polishers within the Union and for export if possible.

A subsidiary Company—the Carrara Marble Company—has been formed to undertake the work of cutting and polishing of the marble and to contract for the installation of finished marble in buildings as well. This Company has erected an up-to-date cutting and polishing plant at Rossburgh, Durban.

ORIGIN OF THE TRAVERTINE AND ITS RELATION TO THE EXISTING SPRINGS.

The structural features of the deposits as described indicate that they were formed by the deposition of calcium carbonate by spring water and in this connection it is interesting to consider the composition of the water at present issuing from the springs in close proximity to the deposits.

The springs at Isinuka and the Crater are very similar in character. They are cold, have a high saline content and emit sulphuretted hydrogen which oxidises on coming in contact with air, giving rise to finely divided native sulphur in the water.

A chemical analysis* (by Mr. C. E. J. v. d. Walt, Geological Survey Laboratory) of a sample of water from the spring issuing close to the river below the Crater deposit, collected in the latter part of November, 1934, i.e. during the rainy season gave the following results:—

---

* In the water the magnesium and calcium occur mostly as the more soluble bicarbonates. From the sample of water $CaCO_3$ was being deposited indicating that the water is saturated with calcium carbonate. A trace of H_2S. is present.

	Grams per Litre.	*Percentage of Total Solids.*
CaO	0·62	2·5
MgO	0·44	1·7
Na_2O from Na_2SO_4 and Na_2CO_3	5·49	21·9
Na from NaCl	4·53	18·1
SO_3	4·52	18·1
Cl	6·78	27·9
CO_2 by difference	2·47	9·8
TOTAL SOLIDS	25·05	100·0

For the Isinuka spring du Toit quotes an analysis by Juritz (" The Underground Waters of Cape Colony " Agricultural Journal C.G.H. Vol XXXIII p. 4, 1908), in which the radicals present are given in grains per gallon of the following compounds:—

Calcium Carbonate	70·6	grains per gallon.
Magnesium Carbonate	29·0	,, ,, ,,
Sodium Carbonate	353·0	,, ,, ,,
Sodium Sulphate	756·0	,, ,, ,,
Sodium Chloride	1118·0	,, ,, ,,
TOTAL SOLIDS	2348·6	

The radicals present do not necessarily exist in the form of the above-mentioned compounds in the water but for comparison the analysis of the water from the spring near the Crater deposit, calculated in the same way gives a strikingly similar result.

Calcium Carbonate	70·2	grains per gallon.
Magnesium Carbonate	65·3	,, ,, ,,
Sodium Carbonate	234·5	,, ,, ,,
Sodium Sulphate	565·0	,, ,, ,,
Sodium Chloride	807·0	,, ,, ,,
TOTAL SOLIDS	1759·0	

Although the waters no doubt ascend from great depth there is no reason to assume that they are juvenile. They are more likely to be derived from some deep-seated circulation of metoric waters probably diluted to some extent near the surface by coming in contact with the ordinary underground water.

In both cases the water contains appreciable amounts of calcium carbonate in solution. It is however not the most abundant salt present. All the other salts with the exception of magnesium carbonate are highly soluble and as the water is not saturated with respect to those more soluble salts they were not deposited as long as there was free flowage or seepage of the spring water. Any small quantities that may have been deposited by evaporation would be dissolved and removed by rainfall. If it is assumed that the composition of the spring water has not undergone any change this would explain why the material deposited in the part is now composed principally of calcium carbonate with a small amount of magnesium carbonate.

Analysis of Travertine from Crater Deposit (by C. F. J. van der Walt, Geological Survey Laboratory).

	Per Cent.
$CaCO_3$	97·27
$MgCO_3$	1·59
$CaSO_4 \cdot 2H_2O$	0·98
Al_2O_3 plus Fe_2O_3	0·23
SiO_2 plus insol.	0·10
	100·17

Analysis of Travertine from Isinuka or Sulphur Springs Deposit (supplied by St. Johns Marble Co.).

	Per Cent.
$CaCO_3$	93·24
$MgCO_3$	2·65
Al_2O_3 plus Fe_2O_3	0·56
SiO_2 plus insol.	1·55
Water, organic matter, Sulphate, Alkalies, etc. (by diff.)	2·00
	100·00

Besides the composition of the spring water there are several other factors such as the rate of flow, temperature of water, climate, affecting the precipitation of mineral salts carried in solution, all of which may have changed.

Precipitation of calcium carbonate is taking place at present but not on the same scale at which it is conceived to have occurred when the large deposits at Isinuka and " The Crater " were formed, even if the time factor be extended considerably.

The conclusions is therefore that the rate of flow of the springs and the precipitation of calcium carbonate has diminished considerably since the time when the existing travertine deposits were formed.

ACKNOWLEDGMENTS.

The deposits described in this report were visited during the atter part of November, 1933, in the company of Mr. V. H. M. Barrett, Deputy Commissioner and Inspector of Mines for Natal and Mr. C. Orpen, Claim Inspector, to whom the writer's thanks are due or valued assistance and suggestions.

The writer also wishes to thank the St. Johns Marble and Base Mineral Ltd., for the facilities offered in connection with the visit o and examination of the deposits.